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14. ABSTRACT The Valley hospital proposes to continue and expand their current work to implement an Emergency Department (ED) Patient and Mobile Equipment Tracking pilot project in an effort to identify key opportunities to drive operational efficiency, improve patient satisfaction, and increase asset utilization. The project will also focus on researching opportunities to leverage the technology in a military setting in collaboration with the Telemedicine and Advanced Technology Research Center (TATRC). The proposed research project intends to demonstrate the platforms for consumption by a common user interface and application. The project is intended to lead the way to further study the application throughout the hospital in the inpatient and peri-operative setting.				
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Table of Contents

	<u>Page</u>
Introduction.....	1
Body.....	1
Key Research Accomplishments.....	5
Reportable Outcomes.....	7
Conclusion.....	8

Introduction

The Valley Hospital continues to expand their work on medical error reduction by implementing a Mobile Equipment Tracking system utilizing a real time location system along with radiofrequency tagging. The initial phase of the project built a hospital-wide infrastructure of RTLS hardware and defined the desired zone-based configuration needed for adequate tracking. AgileTrac software was then installed to pass the milestone marks to disparate systems for the purpose of location, preventative maintenance or repair of tagged equipment. The proposed research project intends to demonstrate the effectiveness of using middleware to homogenize data produced by varied real time location system (RTLS) platforms for consumption by a common user interface and application. The project is intended to lead the way to further study of the application throughout the hospital in the inpatient and peri-operative setting tagging other assets as well as patients and caregivers.

Body

Background: The Valley Hospital proposes to implement a real time location system (RTLS) to locate asset management and patient flow in a healthcare setting. This system will be implemented in a phased approach to accommodate the absorption of the technology and integration with existing workflow processes and computerized information systems. This proposal will detail the Hospital's intent to implement a pilot project in the Emergency Department (ED) Patient flow and include Mobile Equipment Tracking in that area to identify key opportunities to drive operational efficiency, improve patient satisfaction, and increase asset utilization. The pilot project will also focus on researching opportunities to leverage the technology in a military setting in collaboration with the Telemedicine and Advanced Technology Research Center (TATRC).

The RTLS industry contains many proprietary, vendor-specific hardware and software platforms which are designed to 1: promote a particular technological development agenda, or 2: overcome a perceived or actual environmental characteristic. This proposed project is not intended or designed to promote or advocate for one technology over another, but to promote a framework where multiple, disparate RTLS technologies can coexist in the same ecology and allow their disparate outputs to be merged into a cohesive, organized flow of information. This research project proposal intends to demonstrate the effectiveness of using middleware to homogenize data produced by varied real time location system (RTLS) platforms for consumption by a common user interface and application.

Subsequent phases of the project will include Patient flow, clinical process management and Mobile Equipment Tracking in the Perioperative Suite, expansion of Mobile Equipment Tracking to include beds, intravenous infusion pumps and other movable assets of critical clinical nature for the entire campus, additional phases will include patient flow and clinical process management to improve critical or time-sensitive events.

Hypothesis: We believe that diverse, disparate, wireless real-time location tracking technologies can co-exist in a single environment and that the positional information they provide can be merged into a single set of data outputs that can provide a single pane-of-glass view of the real-time location of materiel assets, clinical process management and patient flow that these data outputs can also be sent to ancillary asset and workflow systems based on their parochial interests. We further believe that, by enabling this homogenization of information supplied by the most appropriate RTLS systems that are installed, we can improve operational efficiency, improve patient satisfaction, increase asset utilization and positively impact patient safety

Technical Objectives:

- Select and implement a Real-Time Location System (RTLS) in The Valley Hospital Emergency Department. This implementation will provide relevant (room-level or bay-level) positional information for tagged movable assets and during a future phase, patients admitted to the Emergency Department. The system will provide zonal positional information for all other areas of the Hospital Emergency Department.
- Ensure the solution complies with all RF transmission guidelines to avoid interference with Hospital's wireless communication systems and clinical modalities.
- Select and implement an RTLS Server ("middleware") application. The purpose of the RTLS Server will be to homogenize the output from the RTLS System for consumption by heterogeneous computerized information systems. The middleware application must be scalable to allow for inputs from multiple, disparate, RTLS systems as well as multiple, diverse, parochial information systems. The middleware application must be compatible with multiple interface specifications for the heterogeneous computerized information systems. The middleware application must contain user-configurable, rules-based workflow and notification components to guide information delivery and notification processes for key events.
- Interface the RTLS Server to the Hospital's Emergency Department information system. This interface will provide real-time positional data which will be consumed and processed by the information system to display the current location for each admitted patient on the unit in a later phase.
- Interface the RTLS Server to the Hospital's bio-medical device asset management system. This interface will provide real-time positional data which will be consumed and processed by the asset management system to facilitate asset location for any device needing repair.

- Select and implement an RTLS in The Valley Hospital for positional reference of staff and patients throughout the campus. The system will provide zone-based coverage for patient care units and designated areas. The system will provide threshold or other relevant positional information to the RTLS Server for analysis of event-driven triggers in a later phase of the project.
- Select and implement an RTLS in The Valley Hospital for positional reference of materiel assets throughout the campus. The system will provide zone-based coverage for patient care units and designated areas. The system will provide relevant positional information for key areas within the patient care units and other designated areas in a later phase of the project.
- Identify opportunities to leverage the use of the RTLS Server rules to enhance patient throughput initiatives and other operational efficiencies through the improved utilization of materiel assets, coordinated event alerting based on key relevant positional triggers to improve workflow processes in a later phase of the project.

Military Significance: Creating a method for homogenizing location data from disparate RTLS systems that will allow multi-vendor sourcing of hardware and accelerate the adoption of multi-site implementations. Current manual asset management processes often cause insufficient availability of assets, labor-intensive physical inventories, shrinkage and inadequate asset maintenance as well as uncertainties in readiness status, which can impact the critical patient care issues. Real-time asset management systems based on RTLS technology can reduce inventory requirements, ensure adequate inventory to meet operational demands, minimize shrinkage of assets, and improve productivity and accountability. The technology platform being introduced will enable these benefits and provide an open framework on which vendors can create solutions.

The military already has disparate RTLS systems actively deployed. This project would allow for the continued selection and implementation of diverse RTLS technologies that are designed to meet the environmental and process requirements while enabling cross-departmental information sharing and more effective asset mapping for logisticians.

Public Purpose: This project would provide a framework for product evaluation and selection by organizations wishing to invest in RTLS technology but confused by the diverse solutions and lack of standardization. Our project will afford organizations the opportunity to select the most appropriate RTLS technology solution(s) for their environment while allowing for information-sharing requirements to parochial, legacy information systems. Wifi-based RTLS systems could coexist in the same organizational ecology as RF/IR systems based on the department or unit's needs. The positional information available from each RTLS would be processed by the centralized RTLS Server and integrated through its rules engine to spawn correlated event notification to interested parties and present a holistic view of managed assets.

In addition to the technical application advancement, the ability of the system to generate milestone marks as well as location of patients and assets will be a tremendous assist to gaining healthcare efficiency, increased patient satisfaction and enhanced patient safety.

Healthcare organizations struggle with the ability to track their assets for example, I.V. infusion pumps. The ability to readily locate pumps at the moment they are needed will ensure the patient is receiving their medication therapy in a timely manner, which is an important patient safety issue. The fact that the employee didn't have to spend an excess amount of time to locate the pump is an employee satisfier. The system's ability to track assets will help organizations to purchase the right amount of pumps, creating cost savings.

The ability to track patients through their steps in the care process using a real time location system will help healthcare organizations learn what processes can be improved upon to increase efficiency and provide timely, safer care for patients. The milestone marks generated by the RTLS will be far more objective allowing benchmarks to be established so healthcare organizations can use them in their process improvement activities. In so doing, care will be delivered to patients in a way that will minimize risk, minimize bottle-necks in the system and hasten diagnosis and start of treatment to the patient. In addition, creating capacity for staff to spend more time at the patient's bedside.

Collectively, these enhancements will create safe, patient-centered, effective, efficient and timely care. These elements reflect the vision of health care for the American public written in the Institute of Medicine's report, "Crossing the Quality Chasm."

Methods: The testing methodologies to be used will confirm the accuracy of the solution, displaying the asset on an electronic map that consistently corresponds to a real-life physical location. The process for vetting the solution will require repeatable results establishing positive identification that an identified asset's RTLS Server location matches its real-life, physical location whether it be zone-based or room-based level of granularity. We will perform this testing using a tagged asset. Using the positional reference software map contained in the RTLS Server, observe and compare that that to the physical "real life" location. The testing method will be deemed successful when we can confirm a statistically significant number of occurrences that the tagged asset is displayed within 3 feet of its "real life" location. In zone-based coverage areas, confirm that a statistically significant number of positive occurrences exist to locate the asset in the software match the "real life" location. Further testing will include confirmation that interfaced heterogeneous information systems include the appropriate location values as are observed within the RTLS Server. This location information must be consistent and updated in the heterogeneous information system within 300 milliseconds of a location-change event generated from the RTLS.

Key Research accomplishments

8/2012 - The research leadership team completed their negotiation and has an executed contract with GE Healthcare/Agile-Trac for ED patient flow and dashboards.

4/2012-8/2012-The dashboard is comprised of 15 timestamps that align with the timestamps currently being collected by a manual process. The essence of the research in this project is to compare the electronic timestamp captured through the Agiletrac RFID/RTLS system to the manually entered time.

9/2011-12/2012-Test and refine radio-frequency (RF) coverage to meet desired zone-based configuration in all locations to ensure RF design is benign and introduces no negative impact to existing, in-use, RF services.

9/2011-10/2012-Test and refine relevant-location solution (infra-red, ultrasound, etc) to meet desired positive location identification in Emergency Department

The AgileTrac generated reports designed to follow the IV pump cleaning process reveal a 55% compliance rate with pumps.

The research team has continued to make rounds to patient care units twice a day to observe IV pump cleaning procedure and movement. Observation found that pumps are being cleaned but not following the flow as designed 38% of the time. This is accounted for by two process work-arounds, the RN was observed as finding a soiled pump and cleaning it and bringing it to the patient's room for use. The service associate responsible for cleaning the pump is cleaning it in the patient's room as part of the terminal cleaning process once the patient is discharged. The materials management employee in the Emergency Department has completed his training and is managing the IV pumps with great success. A measurement of this success will be reported next Quarter.

9/2012-ongoing-Install additional hardware, (cabling and/or signposts) to meet location identification. Our focus during this period of performance has to increase granularity to the Room Level in medication rooms on each patient care unit. We are also trying to develop a mobile device that would help us to identify a more precise location of the tag within the zone. In addition to that we made a request to GE to start using "Virtual Wall" devices on each entrance/ exit to minimize faulty "Illegal Move" alerts.

This issue arises in the Emergency Room in which distinction of location may be by curtain or a particular space along a hallway and not by a physical barrier of a wall. This will be useful when equipment needs to be located to this degree of granularity.

9/2012-ongoing-Modify legacy Emergency Department computerized information system to allow for real-time location of tagged patients.

9/2012-ongoing-Install additional hardware, (cabling and/or signposts) to meet location identification

10/2012- RTLS Server Software Configuration: Configure patient locations and configure notification and alerting rule

10/2012-ongoing-Configure and document workflow processes for patient tagging.

9/2012-ongoing-Install and test Meditech EDM Bi-directional interface work between Valley, GE and Meditech, the hospital's healthcare information system vendor to define and fine tune the needs of the interface between the systems has been ongoing.

10/2012-ongoing-The implementation team for this phase of the project has been established and has been meeting to validate the accuracy of the timestamps so GE can go back to their development group and build them according to the validated specifications. The process for tagging patients, de-tagging patients and cleaning the tags for recycling is being defined along with policy and procedures written.

11/2012-ongoing-A communication plan is being developed to help staff understand the technology and then to be able to explain it to patients and their family and answer their questions and concerns.

11/2012-Ongoing-The drop boxes used to store and disassociate the tag from the patient have been ordered, received and installed. Much discussion with the Central Sterilizing department, Infection Control Department and the members of the project steering team have been meeting to define a suitable process for collecting, cleaning and redistributing the tags.

11/2012-ongoing-Discussions between the Marketing, Clinical Education departments, Patient and Family Centered Care Advisory Council and the project steering team have crafted talking points as well as posters and public communication strategy to educate our patients and staff on the technology and its purpose. We want to be sure the staff understand the technology and then be able to explain it to patients and their family and answer their questions and concerns.

10/2012-12/2012-The GE Agile-Trac technical team has created the timestamps, metrics and dashboard and the Valley Hospital project team has reviewed and validated the specifications.

12/2012-ongoing- GE Agile-Trac is presently building the software and will be prepared to begin on-site testing 1/2013.

Reportable Outcomes

The AgileTrac generated reports designed to follow the IV pump cleaning process reveal a 55% compliance rate. The research team has continued to make rounds to patient care units twice a day to observe IV pump cleaning procedure and movement. Observation found that pumps are being cleaned but not following the flow as designed 38% of the time. This is accounted for by two process work-a-rounds, the RN was observed as finding a soiled pump and cleaning it and bringing it to the patient's room for use. The service associate responsible for cleaning the pump is cleaning it in the patient's room as part of the terminal cleaning process once the patient is discharged. The materials management employee in the

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The research leadership team has completed their validation of the timestamps and GE is in the process of building the software according to the agreed upon specifications. There have been numerous Webex meetings to show draft work of the electronic timestamps.

The work is 80% complete with 100% completion expected by year end 2012.

This is an important step in the research proposal since the timestamps create the real measure of comparison to the manual timestamps.

The Timestamps that will be measured are:

Arrival to Triage Location**
Duration in Waiting Location
Duration in Triage Location**
Registration to Triage Location
Registration to Assessment Location
Triage location to Assessment Location
Triage location to Inpatient Bed Location**

Total Duration in Assessment Location
Total Duration in Off Unit Location (Radiology)
ED Census
ED LWBS**
Admit Order to Bed Request
Admit Order to Patient in Bed Location
Discharge Order from ED to tag in drop box.
LOS for non-admitted ED patients**

Conclusion

The extended period of contract negotiation with GE Healthcare has delayed the overall project however the researcher believes that this was time well spent. The clarity in the definition of the timestamps as spelled out in the contract is now reaping its reward. The GE technical team has been able to develop the timestamps quickly and to specification which in turn hastened the validation time. Once the number of timestamps was agreed upon in the contract, it then helped to clearly define the metrics used to create the milestones. The researcher believes that this will be the most accurate RTLS measure for comparison with the manual milestone.

The ability to reach the room and sub room granularity for patient movement and placement has been a reassuring advancement in the ability to capture meaningful timestamps.

The two advancements just described together, provide clear signs that the data capture phase of this research should be reliable.